AN ANALYSIS OF AGGREGATE TIME SERIES CAPITAL GAINS EQUATIONS

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New Empirical Analyses of Capital Gains Taxation

The Treasury Department today released three new Office of Tax Analysis staff papers on the taxation of capital gains. The papers provide additional evidence supporting the Treasury Department estimates that the President's capital gains proposal will increase Federal tax receipts.

These empirical papers analyze the effect of changes in capital gains tax rates on taxpayers' capital gains realizations and other income sources. The papers analyze prior tax law changes and find significant short- and long-term responsiveness of taxpayers' realizations to lower capital gains tax rates. Taxpayer responsiveness was more than sufficient to increase total Federal tax revenues.

The papers use three different data sources to analyse the effect of capital gains tax rates on taxpayers' realizations: (1) aggregate time-series data (national data for a 40 year period), (2) pooled cross-section tax return data (four years of individual tax return data), and (3) panel tax return data (individual tax return data following the same taxpayers for a five-year period). In addition, the papers improve on the statistical estimation and models of prior empirical studies.

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NEW EMPIRICAL ANALYSES OF CAPITAL GAINS TAXATION

The Treasury Department released today three new staff papers on the taxation of capital gains. These empirical analyses, prepared by the Office of Tax Analysis staff, analyze the effect of changes in capital gains tax rates on taxpayers' capital gains realizations and other income sources. The papers find a significant short-term and long-term responsiveness of capital gains realizations to lower capital gains tax rates. The papers provide additional evidence supporting the Treasury Department estimates that the President's capital gains proposal will increase Federal receipts.

The papers use three different data sources to analyse the effect of capital gains tax rates on taxpayers' realizations: (1) aggregate time-series data (national data for a 40 year period), (2) pooled cross-section tax return data (four years of individual tax return data), and (3) panel tax return data (individual tax return data following the same taxpayers for a five-year period). It is important to note that significant realization effects were found in the three different data sources.

The papers make two improvements over earlier empirical studies. First, they use more sophisticated statistical (econometric) methodologies to account for the non-linearity of the income tax system and the choice of taxpayers whether to realize gains or losses in any given year. Second, the individual tax return studies are the first to incorporate state marginal income tax rates, which also influence taxpayers' decisions on whether and how many gains to realize.

The new analyses find a significant responsiveness of taxpayers' realizations to lower capital gains tax rates enacted in previous tax legislation. The increased realizations resulting from lower capital gains tax rates are more than sufficient to increase total Federal tax revenues after the capital gains rate reductions. These studies analyze prior tax law changes.

The Papers

The papers released today are Office of Tax Analysis (OTA) Papers, which are circulated so that the preliminary findings of tax research conducted by staff members and others associated with the Office of Tax Analysis may reach a wider audience. The views expressed are those of the authors, and do not reflect Treasury policy. Comments on the papers are invited. The three papers are:

OTA Paper #65: "An Analysis of Aggregate Time Series Capital Gains Equations," by Jonathan D. Jones.

OTA Paper #66: "New Estimates of Capital Gains Realization Behavior: Evidence Pooled Cross-Section Data," by Robert Gillingham, John S. Greenlees, and Kimberly D. Zieschang.

OTA Paper #67: "Estimation and Interpretation of Capital Gains Realization Behavior: Evidence from Panel Data," by Gerald E. Auten, Leonard E. Burman, and William C. Randolph.

Paper Abstracts

An Analysis of Aggregate Time-Series Capital Gains Equations. This paper examines the robustness of the estimates of taxpayer responsiveness to capital gains rate changes in aggregate time-series equations. Many prior time-series capital gain analyses have been done without careful attention to the proper econometric specification of the equations. In particular, the paper examines the issues of functional form, the choice of the dependent and explanatory variables, lag length, non-stationary of the data, and simultaneous equation bias. After an examination of these econometric issues, the paper specifies a more appropriate equation for the estimation of the response of capital gains realizations to changes in capital gains tax rates.

The preferred time-series equation estimates a short-run elasticity of -1.2 and a long-run elasticity of -0.9. These elasticities of capital gain responsiveness to changes in tax rates estimate that realizations would more than double in the short-run if marginal tax rates were cut in half, and realizations would nearly double in the long-run. These estimates of the long-run elasticity are higher than most prior time-series equation estimates.

The paper finds, however, that aggregate time-series estimates of the taxpayer responsiveness of capital gains realizations to changes in tax rates are not at all robust to the specification of the regression model. Taxpayer responsiveness can be large or small depending on how the estimated equation is specified. For instance, the use of a narrow definition of wealth tends to bias the estimate of taxpayer responsiveness downward. The paper concludes that tax policy analysts should not rely on time-series estimation to produce definitive results on taxpayer responsiveness due to the sensitivity of the models to specification issues.

New Estimates of Capital Gains Realizations Behavior: Evidence from Pooled Cross-Section Data. This paper develops and estimates a behavioral model of taxpayer response to capital gains taxation using individual tax return data from four

different years. The model estimates the responsiveness of capital gains realizations and four other capital income categories to changes in marginal tax rates (both federal and state). The paper improves the econometric specification of "last-dollar" marginal tax rates, the dynamic "unlocking" of long-term capital gains, and the decision of whether to realize net gains, net losses, or no gains. It also recognizes the importance of the entire progressive rate schedule. Perhaps most importantly, the data base extends over the period 1977 to 1985, thereby including three significantly different regimes of capital gains taxation.

The paper estimates the response to taxpayers to changes in capital gains tax rates in terms of changes in the probability of recipiency of gains and losses, and in terms of the dollar amount of the capital gains realizations conditional on recipiency. The paper finds significant responsiveness in both decisions. For a typical taxpayer, a one percentage point decrease in the marginal tax rate raises the probability of recipiency of gains from 7.6 percent to 8.9 percent. Conditional on recipiency, and evaluated at the sample average marginal tax rate, the elasticity of the amount of gains with respect to the marginal tax rate is approximately -1.6. Simulation of the two effects at 1985 levels implies that the aggregate point elasticity of net long-term gains, net of carryover, with respect to the effective marginal tax rate is approximately -3.8. Due to feedback effects, the alternative minimum tax and other factors, the arc elasticity of gains with respect to discrete changes in statutory rates would be substantially lower.

The pooled cross-section data estimates imply that the realizations response would be sufficient to yield revenue increases from capital gains rate reductions. Employing a measure of the year-to-year change in the tax rate schedule to allow for temporary unlocking effects, the paper also finds a significant long-run tax impact. The other primary result is that conversion of ordinary income to capital gain income in response to lower capital gains tax rates was not evident from this data. The existence of a large flow of unrealized gains should provide ample theoretical plausibility to the strong behavioral response reported in this paper.

<u>Estimation and Interpretation of Capital GAins Realization Behavior: Evidence from Panel Data</u>. This paper partially reconciles differences among previous individual tax return studies by presenting new estimates of the taxpayer response to changes in the capital gains tax rate. A new behavioral model and improved econometric techniques are applied to a panel of individual income tax returns in which the same taxpayers are followed over a five year period, 1979 to 1983. The model

incorporates the dynamic effect of realization behavior both on whether to realize gains and the amount of gains realized, the effects on other types of capital income and losses of changes in their tax rates, the incorporation of wealth estimates as an explanatory variable, and the use of both state and federal marginal income tax rates.

A simulation method was developed so that the estimated econometric model could be used to examine the effect of changes in the individual income tax rates on aggregate capital gains income and Federal tax receipts. The simulation model is important to capture the effect that when lower capital gains tax rates increase realizations, the increased realizations force taxpayers into higher marginal tax brackets. Ignoring the interaction of increased realizations and marginal tax rates results in overstated estimates of taxpayer responsiveness. The simulation at 1982 levels finds that a small change in the inclusion rate results in a -2.0 short-run realization elasticity and a -1.6 long-run realization elasticity.

The estimation results imply that taxpayer response to lower capital gains rates is sufficiently large to support claims that lowering capital gains tax rates would increase Federal tax revenues. Much of the disparity between results of prior individual tax return studies is found to result from their failure to properly distinguish taxpayer decisions about whether or not to realize capital gains from their decisions about how much capital gains to realize. In addition, some of the disparity is due to lack of a proper simulation methodology that accounts for the simultaneous determination of capital gains realizations and marginal tax rates on capital gains.

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1. INTRODUCTION

The current debate over the direct and indirect Federal revenue effects of reductions in the marginal tax rate on capital gains highlights the importance of finding the underlying reasons for the lack of a consensus. The issue of whether long-term capital gains realizations should be treated as ordinary income, or be given preferential treatment, has important implications for allocative efficiency, distributional equity, and the simplicity of the tax code. One possible explanation for the disparate views involves differences in the way various time-series regression models are specified, since these models yield measures of the sensitivity of capital-asset realizations to changes in the marginal tax rate on capital gains. This area deserves careful attention.

Time-series tax elasticity estimates have been used in simulation models to produce revenue estimates in several recent studies dealing with the revenue consequences of changes in the taxation of capital gains. For example, recent simulation studies by Darby, Gillingham, and Greenlees (1988) and by Toder and Ozanne (CBO, 1988) relied on aggregate time-series estimates of the behavioral response of taxpayers to changes in capital gains taxation for the period 1954-1985. Obviously, revenue estimates are sensitive to the tax elasticity estimate that is used in the simulation model. While all of the aggregate time-series studies find that increases in the marginal tax rate discourages realizations, the magnitude of the estimated response varies considerably. In a recent paper, Auten, Burman, and Randolph (1989) present a summary table which shows the wide range in aggregate time-series tax elasticity estimates. These estimates range from -0.06 to -1.51. With the exception of the study by Auerbach (1988), the importance of the specification issue to the capital gains debate is a matter that largely has been overlooked.

This paper examines the robustness of capital gains tax elasticity estimates to alternative regression equation specifications. Only single-equation regressions using aggregate time-series data are studied. The historical period that is examined spans 1948 to 1987. Specifically, functional form, choice of dependent variable, the explanatory variables included in the design matrix, lag length, nonstationarity of the data, and simultaneous equation bias are some of the issues that are addressed. Our intention is to use what we discover about these various aspects of equation specification to specify a more appropriate equation with which to estimate the response of realizations to changes in the marginal tax rate.

In general, we find evidence that suggests that aggregate time-series tax elasticities are <u>not</u> at all robust with respect to specification of the regression model. The implication of our findings is that the elasticity can be made either large or small depending on how the estimating equation is specified. Because of this troublesome sensitivity, aggregate time-series equations cannot be relied on to produce what could be termed a definitive elasticity estimate. This means that tax policy analysts must look elsewhere for more credible elasticity estimates. A better alternative may be the use of elasticity estimates from panel or pooled cross-section microdata in combination with estimates from time-series data.

The plan of this paper is as follows. Section 2 provides a brief summary of some of the time-series equations used in previous studies. This discussion serves as a starting point for the analysis that follows.

Section 3 discusses the importance of equation specification to valid estimation and statistical inference. Specification error and its implications for least-squares estimation and hypothesis testing are also discussed. A specification test developed by Davidson and MacKinnon (1981) is used to examine the equations specified in recent studies by the Treasury Department (1985). Cook and O'Hare (1987). Toder and Ozanne (CBO. 1988). Darby et al. (1988). Minarik (1988). and Kiefer (1988). This test should permit identification of a best. or group of best. equations that can serve as a starting point for our search to find a better estimating equation.

Section 4 deals with specification searching that is undertaken to discover a more appropriate regression model. Modifications that involve additional explanatory variables. expectations of some of the explanatory variables. the borrowing issue. and portfolio shifting precipitated by changes in the differential between the marginal tax rates on ordinary and capital-asset income are examined.

Finally. Section 5 presents the regression results for the preferred regression specification. The strengths and weaknesses of this equation are discussed. as well as several caveats about the use of aggregate time-series equations to estimate capital gains tax elasticities. In addition. elasticity estimates are presented for various combinations of alternative capital gains measures and alternative functional forms for marginal tax rates in order to assess the impact on the tax elasticity coefficients.

2. PREVIOUS TIME-SERIES STUDIES

Table 1 presents the various specifications for the equations used in the six studies cited above. Included is a description of the data and the historical period used. The equations are grouped according to whether the data are expressed as first-differences or levels. On the one hand. the equations specified by Cook and O'Hare. the 1985 Treasury Department study. and Minarik use first-differences of unlogged data. On the other hand. the equations specified by Darby et al.. Toder and Ozanne. and Kiefer are generally specified in terms of log-levels of the variables. It is shown in Section 3 that the use of differenced data to achieve stationarity and. thereby. avoid the spurious regression phenomenon noted by Granger and Newbold (1974). receives empirical support from Dickey-Fuller (1979) tests for unit roots.

We examine four separate equations for both Darby et al. and Toder and Ozanne. The equations investigated for Darby et al. are the equations reported in Table 3 of their study. These equations use alternative functional forms from Table-A3 of the study by Toder and Ozanne with the 1985 Treasury study's measure of total realized capital gains and marginal tax rates for upper income taxpayers. In addition. the equations from the Kiefer study, although they deal with simulation and not real aggregate data, are examined in terms of their consistency with real data.1/

The six studies differ in their choice of a dependent variable. The studies by Toder and Ozanne and Minarik use net long-term capital gains in excess of short-term losses as the measure of realizations. All the other studies employ total realized capital gains. This latter measure is computed as net long-term capital gains in excess of net short-term losses plus net short-term gains for those taxpayers with gains from the sale of capital assets.2/

Besides differences in the dependent variable, there also exist important differences in the marginal tax rates that are used. For example, Cook and O'Hare use the maximum marginal tax rate on capital gains. Darby et al. use the 1985 Treasury study's marginal tax rate for upper income taxpayers, while Toder and Ozanne employ a weighted average of marginal tax rates for all taxpayers. Valid arguments can be put forth to justify the use of the alternative measures of capital gains as well as the various definitions of the marginal tax rate variable.3/

In addition, there are significant differences in the variables that are included in the design matrix to capture movements in economic activity and the wealth of taxpayers. According to economic theory, taxpayers may choose to realize capital gains in order to rearrange their financial portfolios or to finance consumption and investment in consumer durables. In general, the amount of capital gains that are realized will be related to the stock of wealth in capital assets and economic activity.

Most of the studies proxy the wealth of taxpayers with taxpayer holdings of corporate equity. This is done because there is no directly observable measure of total accrued gains since the tax basis of capital assets cannot be observed until the assets are sold or exchanged. Proxies for total accrued gains can be constructed with Flow of Funds data, and then can be used in estimating regressions. For example, Auten has constructed such an historical series for accrued capital gains using asset revaluation data from the Flow of Funds accounts for the post-World War II period up through 1985. However, because of measurement errors, this will result in biased regression estimates owing to the errors-in-variables problem.

With regard to variables that reflect change in economic activity, the studies use the level of GNP, changes in GNP, and some measure of the price level, such as the GNP deflator, or the Standard and Poor's price index. Both GNP and equity holdings are measured either in nominal, or real terms, depending on the study.

Finally, Cook and O'Hare use the differential between the maximum marginal tax rates on ordinary and capital gains income to capture any income shifting that results from changes in the taxation of capital gains.

3. SPECIFICATION ISSUES AND TESTING

The importance of correct equation specification to valid estimation and inference is well known. In general, the issue of the specification of an estimating equation involves not only the basic structure of the regression model but also includes whether the standard assumptions of the classical regression model are satisfied. These assumptions include: (1) functional form is correct, (2) dependent and independent variables are measured without error, (3) design matrix is correctly specified in terms of the variables that are included and excluded from the regression, (4) regression error has a zero mean and satisfies the sphericality conditions, (5) design matrix has full column rank, and (6) the orthogonality condition holds for all regressors, i.e., there is a zero covariance between the regression error and the explanatory variables. Violation of any one of these has important consequences for the sampling distribution of the parameter estimators and statistical inference.

In applied econometric work, specification error is viewed in a narrower sense and usually falls into one of four categories: (1) incorrect functional form, (2) omitted relevant variables, (3) included irrelevant variables, and (4) incorrect specification of how the error enters the regression equation; i.e., additively or multiplicatively. Specification errors are important because of their adverse statistical consequences. These include biased and inconsistent estimates, inefficient estimates, and incorrect inferences arising from biases in the variance-covariance matrix of the estimators. For example, the omission of a relevant variable from the regression model can result in biased and inconsistent parameter estimates. In addition, incorrect hypothesis tests result because the constructed confidence intervals are too wide; consequently, the null hypothesis is accepted too often as true.

Specification Tests:

To understand better whether the time-series equations used in previous studies are consistent with the data, a specification test is employed to examine the equations detailed in Table 1. The Davidson and MacKinnon (1981) non-nested specification test is used to evaluate the equations. While there are several specification tests that can be used to examine non-nested regression models (See, e.g., the special issue on specification tests in the Journal of Econometrics, (1983)), the Davidson and MacKinnon test was chosen because it has correct asymptotic size, good asymptotic power; and, in addition, it is easy to implement. The purpose of the specification test is to isolate those equations that are inconsistent with the data.

The equations can be divided into two groups depending on whether the data are expressed in levels or first-differences. Through so-called artificial nesting of the equations, the test is applied to all of the equations in each of the two groups. For those studies where there are four equations that are examined, the test is first used to find the equation that performs best in the group. This equation is then used to assess the relative performance of the competing specifications in the other studies.

By definition, a non-nested set of equations consists of equations that cannot be derived from one another through simple restrictions, such as zero restrictions. In other words, the union of the design matrices of the different equations is not identical to the design matrix for any one equation. There can be overlapping of explanatory variables, but there must be at least one non-overlapping explanatory variable. See Harvey (1981) and Judge et al. (1984) for discussion of the difference between nested and non-nested sets of equations.

Most of the equations that are investigated are non-nested, but there are several exceptions. For example, the first equation for Darby et al. is a special case of the third equation. Similarly, the first and third equations for Toder and Ozanne are nested in the second and fourth equations, respectively. Finally, the equations for Kiefer with one through four lags on the marginal tax rate are all special cases of the equation with five lagged values of the tax rate. The fact that there are several nested equations does not have an impact on the overall findings of the specification test. In all cases, the lower dimensional nested regression models are obtained from the general models through zero restrictions.

Technically, a nested specification test should be used for nested equations. A comparison of adjusted R-squared values could be used as the testing procedure. For the nested regressions, the results of the Davidson and MacKinnon test were the same as the results from the adjusted R-squared comparison.

The Davidson and MacKinnon test was applied to the equations in each group separately. That is, the equations using differenced data were evaluated relative to each other, and the same was done for the equations using levels of the data. Although the right-hand-side (RHS) variables can differ, it is necessary for the dependent variable to be the same, or that some transformation of the same variable be used, e.g., logarithmic transformation. For those equations where the dependent variable is different, appropriate changes were made so that the dependent variable was the same in conducting the test.

The Davidson and MacKinnon test is implemented as follows. Let

$$H_0 : y = X\beta_0 + u, \quad u \sim N(0, \sigma_u^2 I)$$

$$H_1 : y = Z\beta_1 + v, \quad v \sim N(0, \sigma_v^2 I)$$

represent two alternative regression models that purportedly explain movements in the conditional mean of y. X and Z are $(T \times K_0)$ and $(T \times K_1)$ design matrices, respectively. β_0 and β_1 are $(K_0 \times 1)$ and $(K_1 \times 1)$ location parameter vectors, u and v are both $(T \times 1)$ disturbance vectors with classical properties, and y is a $(T \times 1)$ vector of observations on the dependent variable. The OLS estimators of β_0 and β_1 are denoted as $\hat{\beta}_0$ and $\hat{\beta}_1$.

The two regression models are tested by artifically nesting one in the other. This produces the following compound or mixing model

$$y = (1 - w)X\beta_0 + wZ\beta_1 + u' \qquad (1)$$

where w is the mixing or weighting coefficient, and $0 \leq w \leq 1$. A value of zero for w supports the null model, H_0, while a value of one supports the alternative, H_1. To conduct the test, the predicted value of the alternative model is substituted in Eq. (1) to produce the estimating equation

$$y = (1 - w)X\beta_0 + wZ\hat{\beta}_1 + u^{*}. \qquad (2)$$

Davidson and MacKinnon show that the t-statistic on w in Eq. (2) has an asymptotic normal distribution.

Although the Davidson and MacKinnon test is easy to implement, there is a drawback in its use with small samples. Godfrey and Pesaran (1983) show that the effective size or estimated significance level of the test in small samples can be much larger than the nominal size of the test. The result is that the null hypothesis is rejected too often in small samples. Problems with the Davidson and MacKinnon test can be expected when the following conditions hold: (i) poor fit of the true model, (ii) low or moderate correlations between the regressors of the two regression models, and (iii) the false model includes more regressors than the true model. 4/

With regard to the regression models examined in this study, in general, all models had a good fit in terms of multiple correlation coefficients, the regressors in the various models were highly collinear, and most of the regression models had approximately the same number of regressors. Most of the regression models that were examined used the same set or very similar sets of explanatory variables; and, in addition, most equations had a measure of economic activity, a price level measure, and a wealth variable as regressors. Refer to Table 1 to verify that this is the case. While the small sample properties can be of legitimate concern in applied work, it appears that those properties are of minor importance for our results.

Tables 2 and 3 report the results of the specification tests. In carrying out the test, one of the equations is set up as the null hypothesis and the other equations represent a series of alternative hypotheses. The situation is then reversed, and the test is repeated, with each of the alternative hypothesis equations serving as the null and the original null hypothesis serving as the alternative. It is possible for all the regression models to be rejected as adequate representations of the data because no one model is assumed to be the true model in conducting the test. Similarly, it is also possible for all the regression models to be adequate representations of the underlying mechanism generating the data. The specification test is used to evaluate the consistency of each equation with the data relative to the equation that is specified as the null hypothesis.

The relevant test statistic is the J-statistic, which has a standard normal distribution. In implementing the test, each equation is estimated, and the fitted or predicted values are then used as explanatory variables in the artificially nested equation that is estimated for the test. The J-statistic is the t-statistic for the coefficient on the fitted value from the alternative model in each artificially-nested equation, and is a linearized version of the Cox N-statistic. [See Judge et al. for a discussion of non-nested testing procedures that are related to the Cox test.] If the computed J-value is greater than the critical value for the test, the null regression is rejected as adequate relative to the alternative regression model. For a value of the J-statistic smaller than the critical value, the null regression model is accepted as being an adequate representation.

Table 2 provides the computed J-statistics for the equations that use levels of the data. Several basic conclusions can be drawn. First, the four equations used by Darby et al. are very similar, and it is not possible to identify any one equation that is best or worst. Intuitively, this makes sense because the equations differ essentially only in terms of the transformation on the marginal tax rate. Because the capital gains tax-elasticity point estimate of -.67 produced by Eq. (4) has been the focus of some discussion, we chose this specification from the Darby et al. study to conduct the specification test with the equations from the other studies.

Whether the relationship between realizations and the tax rate is semi-logarithmic, or double-logarithmic, does not appear to matter much in terms of consistency with the data. However, it does matter how the tax rate is entered if the elasticity is assumed to remain constant or to change as the tax rate changes. In general, the tax elasticity of realizations increases as the marginal tax rate increases. This occurs because taxpayers become more responsive to changes in the tax rate as the amount paid in taxes on realizations rises due to tax increases.

Second, for the Toder and Ozanne equations, the nominal and real equations that include the first-difference of real GNP perform better than the equations that omit this variable. This suggests that inclusion of some measure of the business cycle on the right-hand side of the estimated equations improves the predictive power of the regression model.

Third, the Kiefer specifications, using alternately lags 1 through 5 on the marginal tax rate, are rejected by both Darby, Gillingham, and Greenlees' Eq. (4) and Toder and Ozanne's Eq. (2). In estimating the Kiefer equations, the Treasury marginal tax rate and the value of households corporate equity holdings in the previous year were used as RHS variables. Finally, Darby et al.'s Eq. (4) is a better representation than the Toder and Ozanne equation for nominal capital gains. This holds whether total or net long-term realized capital gains is used as the dependent variable.

Table 3 presents J-statistics for the equations using first-differences of the data. The Davidson and MacKinnon test was carried out on the equations used by Cook and O'Hare, the 1985 Treasury study, and Minarik using both total and net long-term gains. Real GNP and the GNP price deflator are used in the Treasury equation to avoid the variable problems in the original Treasury equation discussed by Darby et al. The results show that when total realized gains is the dependent variable, both the Treasury and Minarik equations are better than the Cook and O'Hare equation. In addition, the Treasury equation is found to be better than Minarik's equation.

Sharply different results emerge when the dependent variable is changed to net long term capital gains in excess of net short-term losses. All three equations are shown to be inadequate representations of the process generating capital gains realizations.

To summarize the results in Tables 2 and 3. the Darby et al. equation appears to outperform the other equations using levels of the data in terms of its consistency with the data. For those equations using differenced data. the 1985 Treasury study equation is found to be better for the case in which total realized gains is the dependent variable. This was not the case when net long-term gains were used as the dependent variable.

Additional Issues in Specification:

The topics of nonstationarity of the data. the choice of lag length. and simultaneous equation bias are explored in what follows. All of these represent potential problem areas which deserve consideration in the context of equation specification.

Nonstationarity:

Initial experimentation with and without a linear time trend in several of the equations that are examined revealed a troublesome sensitivity of the regression results to detrending of the data. Presumably. the equations expressed in first-difference form were specified in such a way. in part. to adjust for nonstationary components in the data. There is really no way to be certain that this is why first-differences of the data were used. however. since there is a lack of discussion of the behavior of the data over time.

The issue of nonstationarity is important because. as is well known. failure to account for the secular movement or low-frequency component of time series that are related in equations can bias regression results. In general. it appears that this issue has not been dealt with adequately in the studies under review in this paper. Auerbach (1988) made a similar observation about the lack of attention paid to the nonstationarity issue. In order to account for the nonstationarity of the data. Auerbach includes a linear time trend in estimating his equations using levels of the data. However. as we discuss below. this also results in a specification error because the data are found to be difference stationary time series.

Granger and Newbold (1974) showed that the use of nonstationary data in regressions can result in spurious significant results. Nonstationarity causes a downward bias in the standard error of coefficient estimates which results in inflated test statistics and incorrect inferences. In order to avoid the "spurious regression phenomenon". the use of differences is recommended. Although this is not a panacea. it is better than making no adjustment at all.

In related work. Nelson and Kang (1981. 1984) have shown that inappropriately detrended data can lead to invalid regression results because of inflated test statistics. This occurs when time series that are difference stationary are incorrectly assumed to be time stationary. and. consequently. are detrended by being regressed on a time trend. or some function of time. By definition. a trend stationary time series is one which can be made stationary by regressing it on a deterministic time trend or some function of time. e.g.. a polynomial of second or third degree. On the other hand. a difference stationary time series is made stationary by differencing an appropriate number of times. depending upon the number of autoregressive unit roots in the time series.

Nelson and Plosser (1982) have found that most macroeconomic time series for the U.S. are random walks. which are a class of integrated time series processes. This means that these series are difference stationary.

Tables 4 and 5 present the results of the Dickey-Fuller (1979) tests that were carried out for all the time-series variables used in all the equations examined. This includes both dependent and independent variables. In all. 23 series are examined. Basically. what is at issue is whether a series has a unit root. and if it does. how many times the series must be differenced to induce stationarity.

Table 4 presents results on whether the various series are trend stationary (TS) or difference stationary (DS). A TS series does not have a unit root. while a DS series has a unit root and must be differenced to make it stationary. The Dickey-Fuller test as conducted by Nelson and Plosser is used. To carry out the test. a first-difference of the series is regressed on a constant. a linear time trend. and a lagged value of the level of the series. The computed t-statistic on the lagged value of the series is then used to test the null hypothesis that the coefficient is one. To reject the null hypothesis. the t-value must be large and negative. The computed test statistics in Table 4 show that all the series are DS time series. Critical values for the test statistics are taken from Fuller (1976). Table 8.5.2. p. 373.

Table 5 presents results of an Augmented Dickey-Fuller (ADF) test for stationarity. The test is conducted as done in Engle and Granger (1987). Both second-order and fourth-order autoregressive processes were used to conduct the test. Because the results were the same. the results from the second-order autoregressive regressions are reported. The critical values for the test statistic are taken from the paper by Engle and Granger. The ADF test is used to determine the degree of differencing necessary to induce stationarity in a DS series. Because all levels of the series were found to be difference stationary in Table 4. all levels of the series should be nonstationary. and this is found to be the case in Table 5 as well.

Although the time series that were examined are found to have more than one unit root. the ADF test has low power in small samples. which results in not rejecting a false null hypothesis of nonstationarity. As a check on this. the autocorrelation functions for the first-differences of several of the series were examined. The autocorrelation functions revealed that first differences were adequate to make the series stationary. and that no further differencing was needed.

There are several regression strategies that can be used to avoid the spurious regression phenomenon. First, as recommended by Granger and Newbold, the data can be differenced. Second, one can make sure that all the variables that account for the nonstationarity of the dependent variable are included in the design matrix. This approach is dismissed by Nelson and Plosser as unrealistic. Third, the Engle and Granger approach of using co-integrating and error correction regression equations could be used. Work involving this approach to modelling the process generating capital gains realizations is currently in progress, but the results are not reported. The simplest strategy is the first, and this is the approach taken in this study to deal with the nonstationarity issue.

Lag Length:

It is well known that the choice of lag length has an impact on regression results. This is a result of the efficiency-bias tradeoff that exists in determining the length of distributed lags. If significant lags of a variable are omitted, this will cause biased estimates. On the other hand, an excessively long lag avoids the bias problem, but results in inefficient estimates.

To determine if lag length has an impact on the capital gains tax-elasticities yielded by time-series regressions, two different lag-length determination criteria were used to fit optimal lags to the variables used in Darby, Gillingham, and Greenlees' Eq. (4). The two criteria include Akaike's final prediction error (FPE) and Schwarz's Bayesian information criterion (BIC).5/ Although the FPE is frequently used, it has a tendency to over-fit distributed lags asymtotically. This means that too many lags are specified. Thornton and Batten (1985) recommend its use, but Jones (1989) finds evidence which does not corroborate their results. Lutkepohl (1985) recently has shown that the BIC performs well in fitting appropriate lag lengths in vector autoregressions. Both criteria are used to note whether the optimal lags are the same.

Table 6 presents results on lag length for both the BIC and FPE. The lag lengths are identical for real GNP, the tax rate, and real equity holdings, but they differ for the GNP deflator and lagged capital realizations. As noted above, the FPE tends to over-fit the lag length, which means that too many lags are included, and this appears to be the case here. Also included in the table is the coefficient on the marginal tax rate. The equation using the lag lengths specified by the BIC finds an elasticity of -.83, which is higher than the elasticity of -.61 for the equation using FPE-determined lags.

Thus, the choice of lag length does appear to have an impact on the elasticity estimate. The results on lag length do point out that the Darby et al. equation appears to be misspecified to the extent that lagged values of capital gains realizations and the GNP price deflator are not included as RHS variables.

Simultaneous-Equation Bias:

Finally, a Granger-causality test was carried out using the Darby equation for the sake of illustration. Both multivariate as well as bivariate tests were performed in which four lags on gains and four lags of the tax rate were used. Evidence of feedback was found between capital gains realizations and tax rates. The strength of the feedback is influenced by the equation specification, particularly, whether a contemporaneous term is also included as a RHS variable. There is evidence of contemporaneous feedback between gains and the tax rate. In addition, there is also evidence of feedback between real GNP and equity holdings. Darby et al. point out the importance of the feedback between equity holdings and gains in their study. The results reported here support their view.

Based on these findings for equations using levels of the data, it appears that feedback between capital gains and a subset of the variables included in the design matrix is a matter that should be addressed in deciding on an appropriate estimation technique. That is, the question as to whether ordinary least squares (OLS), or an instrumental variable (IV) estimation procedure, such as two-stage least-squares, should be used needs to be answered.

In previous studies, some attention has been paid to the possibility of feedback between capital gains realizations and the marginal tax rate. For example, the 1985 Treasury study and the study by Darby et al. report that both OLS and IV estimation yielded essentially the same results. Both OLS and IV estimators were used in this study to note the sensitivity of the results to the choice of estimation method for the Darby et al. specification using levels of logged data.

In general, the OLS and IV estimates were largely the same when the marginal tax rate was the only RHS variable that was instrumented. The instruments used included lagged real GNP, the price deflator lagged, lagged equity holdings, and the lagged tax rate. The OLS tax-elasticity estimate was -.59, while the IV estimate was -.54, which is somewhat lower. However, when the equity and GNP variables were also instrumented using the same set of instruments, the OLS and IV estimates varied considerably. More attention needs to be paid to this particular issue, and additional work is being done on this issue currently with equations using differenced data.

The choice of instruments is a non-trivial decision, since the final regression estimates will be sensitive to which instruments are used. It is well known that instrumental variable estimators, in general, are biased in small samples, and that their variances are difficult to establish. In addition, poor results are obtained if a set of instruments is chosen which are not highly correlated with the endogenous variables that are instrumented in the structural equation. See, e.g., Johnston (1984), pp. 363-366 for further discussion.

4. SPECIFICATION SEARCHES

In this section, we attempt to specify an improved aggregate time-series regression equation that can be used to estimate the capital gains tax-elasticity. To accomplish this task, we use the results from the previous section to guide our specification searching. In addition, we also examine modifications involving additional explanatory variables, expectations on a subset of the explanatory variables, the borrowing issue, and portfolio shifting brought about by changes in the taxation of capital gains.

Appendices A, B, and C present selected regression results of some of the specification searching that was done. Data for these regressions were for the most part taken from Flow of Funds balance sheets and the Economic Report of the President, 1989. Only the regressions using differenced data are reported, although the same basic set of equations was also estimated for levels of the data, both logged and unlogged. The stock repurchase series is taken from Shoven (1986). Appendix D presents the data that are used in the estimation, and Appendix E reports simple correlation coefficients for some of the variables used in the regressions.

In Section 3, it was shown that proper equation specification requires that the data be differenced in order to avoid the spurious regression phenomenon. In addition, attention needs to be paid to lag length and possible feedback between capital gains realizations and the marginal tax rate, as well as between realizations and real GNP and corporate equity. Based on the results of the Davidson and MacKinnon specification test, we use Darby et al.'s Eq. (4) expressed in first-differences as our initial equation. The double logarithmic transformation was chosen to minimize potential problems with heteroscedastic regression errors.

Whether the relationship between capital gains and the tax rate is double-logarithmic or semi-logarithmic is a matter that needs to be decided by the researcher, since the data do not support one functional form over the other. The choice depends on whether the elasticity is assumed to be constant or to vary as tax rates change. We assume in what follows that a constant elasticity holds. This assumption is relaxed for the results reported later in the paper in Tables 10 and 11.

Wealth Variables:

Many different variables to proxy for the wealth of taxpayers were experimented with in the design matrix of the regression model. These variables include: Auten's constructed accrued gains series, stock repurchase data, the net worth of taxpayers from the Flow of Funds accounts, and Lindsey's measure of tradable wealth. Lindsey (1986) defines tradable wealth as the sum of the values of land, residential structures, corporate equities, and equity in non-corporate businesses held by households. Data from the Federal Reserve Board's Flow of Funds balance sheets were used to construct this series.

Although the results are not reported for all the experimentation that was done, the use of a wider measure of taxpayer wealth results in an increase in the short-run tax elasticity of gains realizations. In general, the elasticity was pushed above 1 in absolute value.

This is what would be expected to occur in the case where a relevant variable is omitted from the regression model. It is well known that a relevant omitted variable that is positively correlated with an included variable results in an upward bias in the coefficient estimate of the included variable. See, inter alia, Kmenta (1986) for discussion. For example, the inclusion of only part of tradable wealth in the form of corporate equity holdings results in an elasticity estimate that is biased toward zero. This means that the elasticity estimate is smaller in absolute value than it would be if the larger measure of wealth were included in the regression equation. This omitted variable problem arises because the wealth of taxpayers appears to be positively correlated with the marginal tax rate.6/

In the experimentation that was done with alternative wealth variables, including net worth, accrued gains, and tradable wealth, all had a similar impact on the tax-elasticity estimate. Tradable wealth was chosen as the appropriate aggregate measure of wealth in the preferred equation. Accrued gains was not chosen because of measurement errors that would result in an errors-in-variables bias. Similarly, net worth was not chosen because it also includes taxpayers liabilities, and it could therefore vary without any change in potential realizable gains. The stock repurchase series of Shoven as well as the net equity purchase series for households from the Flow of Funds accounts failed to have significant explanatory power, and so they were both dropped from further consideration.

Expectations:

As noted by both Auerbach (1988) and Toder and Ozanne (1988), the forward-looking expectations of taxpayers can have a significant impact on capital gains realizations. In their studies, some form of instrumented single-step expectations of the marginal tax rate were included as RHS variables. Toder and Ozanne failed to find a significant impact for the 1954-1985 period. Auerbach, on the other hand, found that the single-step expectation on the tax rate was highly significant for the period 1954-1986.

The inclusion of 1986, in which there was an announcement effect which taxpayers could take advantage of in realizing gains, explains the difference in the results reported by Auerbach and Toder and Ozanne. In order to avoid the much higher marginal tax rates of 28 and 33 percent that went into effect in 1987, taxpayers accelerated quite noticeably the rate at which capital gains were realized in 1986. For example, total realizations were $168.6 billion in 1985, while they increased to $335.4 billion in 1986 in anticipation by taxpayers of the higher marginal rates introduced by the Tax Reform Act of 1986.

In addition to tax-rate expectations, we consider expectations for other variables. Expectations on real GNP, the price deflator, and wealth holdings were considered. In particular, we find that the expectation of the wealth variable, whether it is equity, or tradable wealth, is significant when included in the regression model. While the coefficient on the tax rate expectation is positive, which means that an expected increase in the future tax rate will cause realizations to increase today, the coefficient on the expected wealth variable will be negative. This means that an expected increase in the value of wealth that can be realized as capital gains tomorrow will cause taxpayers to decrease realizations today.

Borrowing:

According to the borrowing issue, the taking of realizations by taxpayers today to finance consumption and investment in consumer durables, results in a diminished stock of accrued gains and, therefore, smaller potential realizations in the future. Experimentation with individual lagged values of realizations and transformations on lagged realizations showed that a simple three-period moving average of gains had an impact on current realizations. The three-period moving-average is constructed using three lagged values of nominal gains. A priori, we expect gains realized in the past to have a negative impact on gains that can be realized today.

Portfolio Shifting:

The portfolio shifting issue was examined by including the differential between the maximum marginal rates on ordinary and capital gains income. This simple measure was proposed by Martin Baily in unpublished work and, subsequently, was used in Brittain (1964) to examine income shifting for firms. Cook and O'Hare also used this measure in their study, although their results showed that the differential had an insignificant impact on capital gains. Interestingly, the results that they report show that the differential variable had a negative sign, which is not what would be expected a priori. One would expect realizations to increase in response to an increase in the differential between marginal rates on ordinary and capital-asset income. This occurs because assets yielding capital income become more attractive relative to assets producing ordinary income, and taxpayers rearrange their portfolios acccordingly.

In addition, the significant portfolio shifting result that Cook and O'Hare report for the separate net interest and dividends in AGI equation that they estimate must be viewed with some caution. It appears that a specification error in the form of omitting a price index from this equation produces the finding of a significant income shifting effect. The inclusion of the GNP deflator, which is appropriate since real GNP is included as a regressor, eliminates the significance of the differential tax term. Also, careful inspection of the data for the interest and dividends series that Cook and O'Hare use shows that dividends are reported in millions of dollars while interest is reported in billions of dollars. When the two series are added together without adjusting for the different units, the dividend series dominates movement of the combined series.

Portfolio shifting would occur if taxpayers rearranged the composition of their financial portfolios between assets yielding ordinary and capital-asset income in response to a change in the differential between the tax rate on ordinary and capital gains income. In testing for portfolio shifting, an approach similar to that used by Cook and O'Hare was used, but for differenced data. Some experimentation was also done with expectations on the differential. It was not possible to isolate any significant separate effect that the differential had on realizations. To a certain extent, this could be the result of collinearity between the differential tax term and the marginal tax rate on capital gains, which would make the coefficient on the differential variable insignificant.

5. REGRESSION RESULTS FOR THE PREFERRED EQUATION

In this section, we report results for the regression model that incorporates the modifications discussed in the previous sections. Tables 7, 8, and 9 present the regression results.

Most of the previous studies examined the historical period 1954-1985, with the exception of Auten (1981), who used data beginning in 1951. This study extends the sample period back to 1948; and, in addition, 1986, and the preliminary estimate for 1987, are included in the period examined. Auerbach also used 1986 in the regressions that he estimates. The dependent variable in all the regressions is total nominal realized capital gains and the marginal tax rate is that for upper income taxpayers used in the 1985 Treasury study. The choice of these two variables stems from their favorable performance in the specification test.

To assess the sensitivity of the tax elasticity estimates to the choice of capital gains and tax rate measure, Tables 10 and 11 report results for net long term gains and the maximum marginal rate on realizations. In addition, the semi-logarithmic form for the tax rate variable is also used to re-estimate the preferred equation specification.

Table 7 reports results for two versions of the differenced Darby et al. equation. The first version includes equity holdings of taxpayers as the wealth variable, while the second version uses the broader tradable wealth measure. Both equity holdings of individuals as well as equity holdings of individuals yielded similar results, so only the results for the holdings of households are reported.

Adjusted R-squared coefficients, Durbin-Watson statistics, Box-Ljung portmanteau Q-statistics with marginal significance levels in parentheses, and degrees of freedom for each equation are reported. The Q-statistics are used to test for a random correlogram for the regression residuals, and permit testing for autoregressive (AR), moving average (MA), or some combined ARMA process for the residuals. Computed t-statistics for the coefficient estimates are reported in parentheses.

The following conclusions can be drawn. First, the elasticity estimates are sensitive to the choice of sample period. This sensitivity is due to whether 1986 is included, and also is a function of whether the particular historical period that is examined extends back to 1948. Second, the elasticity estimates are smaller for the first version of the equation that includes only equity holdings, and not all of tradable wealth. Note that the use of tradable wealth in the specification appears to improve the overall fit of the regressions. The adjusted R-squared coefficients increase and the Q-values are generally lower. However, the Durbin-Watson statistics are uniformly lower with the use of the broader measure of wealth.

Table 8 reports results for the preferred equation specification. There are two versions of the preferred specification: one with equity holdings only, and the other with tradable wealth. The preferred specification includes a three-period moving average on nominal realizations, the single-step expectation of the marginal tax rate, and the single-step expectation of the wealth variable that is included in the equation. The regressions are estimated with perfect foresight expectations. This means that the actual values of the variables are used as the expected values.

All variables are expressed as the unweighted first-difference of natural logarithms, which means that all are expressed as approximate percentage changes. Given this particular transformation on the data, our equations explain the percentage change in nominal capital gains realizations. Also, except for the moving-average term, all variables on the right-hand side of the regressions are expressed in real 1982 dollars using the GNP deflator to adjust the nominal values.

There are several interesting conclusions that can be drawn. First, the tax elasticity point estimate varies with the wealth variable that is used. Second, the expected tax rate variable is highly significant when 1986 is included in the sample, but becomes insignificant when 1986 is omitted. This occurs because the future tax rate is picking up the announcement effect in 1986. Third, the expectation on equity has the appropriate algebraic sign, but is never significant.

Fourth, the expectation on tradable wealth has the right sign, and is significant in two of the four equations; and it is close to being significant in a third equation. It is interesting to note the impact that the broader measure of wealth has on the size of the future tax coefficient. It increases the coefficient in all cases. This stems probably from the omitted variable problem discussed previously. Fifth, the moving average variable in general has the right sign, but it is only significant in one equation.

Finally, because the inclusion of 1986 determines whether the expected tax rate is significant, an argument can be made that it should be viewed as an outliner year. In order to adjust for this, an intercept dummy variable is included for those equations which are estimated over the period that includes 1986. The dummy takes a value of 1 in 1986 and 0 for all other years. Table 9 reports these results, but only for the regressions with tradable wealth. The dummy variable is found to be highly significant for all equations, and the significance of the expected tax rate drops noticeably. These results show how extremely sensitive the expected tax rate is to whether or not 1986 is included in the sample period, and whether a dummy variable is used to capture the structural change in the regression model that apparently takes place in 1986.

Short-Run and Long-Run Elasticities:

Discussion has focused on the quantitative difference between the short-run and long-run impact of changes in the marginal capital gains tax rate. In general, the short-run or temporary impact is larger than the long-run or permanent effect. Short-run and long-run tax elasticities are computed for our regression model using the results in both Tables 8 and 9. Only the elasticities based on the regressions using tradable wealth are reported.

In Table 8, the short-run elasticity over the period 1954-1986 is -1.13, and for the 1948-1986 period it is -1.14. The long-run elasticity, which is the sum of the coefficients on the current and expected tax rates, is -0.18 for the period 1954-1986, and a higher -0.25 for the 1948-1986 period. These estimates, of course, include the effect on the future tax rate of including 1986 in the sample without any adjustment with a dummy variable.

The short-run and long-run elasticities are different in Table 9, where there is a dummy variable adjustment. The estimates are higher, especially for the long-run estimates. The short-run elasticity is -1.15 over 1954-1986, and it is -1.17 for the 1948-1986 period. The long-run elasticities are -0.74 and -0.89 for the 1954-1986 and 1948-1986 periods, respectively.

Additional Regressions, (1948-1987):

This section reports regression results for the sample period extended up to 1987. In addition, the semi-logarithmic functional form for the tax rate is used, and net long-term gains are substituted for total gains. This allows us to note the sensitivity of the tax-elasticity estimates to both changes in the preferred equation specification. In addition, tradable wealth, as previously defined, and a narrower definition of tradable wealth that includes only corporate and non-corporate equity are used.

There are several aspects of the broad measure of tradable wealth that may result in its not being the best measure of aggregate taxpayer wealth, since it includes all assets that are subject potentially to the capital gains tax. For example, owner-occupied homes, i.e., residential structures and land, are infrequently subject to the capital gains tax because of the roll-over provision and step-up in basis at death. In addition, non-corporate equity is measured at replacement cost, and not at market prices, which could have an impact on its reliability as a measure of accrued gains. However, an argument can be made that all capital assets in the taxpayer's portfolio that are potentially subject to the capital gains tax should be included in the aggregate wealth measure.

Experimentation that was done using the double-log specification with levels of the data for the four components of tradable wealth showed that corporate equity, non-corporate equity, and residential structures have significant explanatory power for total capital gains realizations. This was true for both the 1948-1986 and 1948-1987 periods. However, land turned out to be insignificant in the regressions which had the four components entered separately. On the basis of these regressions, it appears that the use of the broad measure of tradable wealth is justified. This also lends support to the earlier conclusion that the use of a narrow measure of wealth will result in a downward bias of the tax-elasticity estimate.

Tables 10 and 11 report the regression results for the additional runs. The tables include parameter estimates with t-values in parentheses, adjusted R-squared, and also the short-run and long-run tax-elasticities, and short-run and long-run revenue-maximizing tax rates. The revenue-maximizing tax rate is given by -1/b, where b is the coefficient estimate on the tax rate in the semi-logarithmic form. The coefficient b gives the proportional change in realizations brought about by a 1% point change in the tax rate. Tax-elasticities are computed by multiplying b by the marginal tax rate of interest. An argument can be made that it is more reasonable to use the semi-logarithmic functional form since the tax-elasticity of realizations should increase as the tax rate increases.

Table 10 presents results that compare equations using total and net long-term gains and the semi-logarithmic form. Specifications (1) through (6) use the tax rate for upper income taxpayers and net long-term capital gains. Because of some doubt about the accuracy of the 1987 preliminary estimate for net long-term gains, the data run up through 1986 only. Specifications (7) and (8) present results for the semi-logarithmic form of the preferred equation.

Several points can be made. First, there is little difference between the short-run elasticity estimate in the double-log specification (1) and that given by the double-log specification (8) in Table 8. The former estimate is -1.19, and the latter estimate is -1.14. This suggests that there is little difference between using total or net long-term gains with the upper income tax rate in double-logarithmic form. The short-run elasticity estimates also are almost identical when the intercept dummy is used. Second, the long-run tax elasticities are somewhat higher for the equations that use net long-term gains. The long-run elasticities run from -0.44 to -0.96 for the regressions with and without a dummy variable, respectively. The corresponding elasticities for the equations using total gains run from -0.25 to -0.89.

Third, regarding the semi-log specification, a comparison of specifications (5) and (6) with (7) and (8) is informative. The former equations use net long-term gains, while the latter use total gains as the dependent variable. The coefficient estimates on the current and future tax rates are almost identical. The long-run revenue-maximizing tax rate is computed by summing the coefficients on the current and future tax rates and then computing the negative of the reciprocal of the sum. The only problem with these estimates is that the long-run revenue-maximizing rate was an implausible value in specification (7). This can be attributed to the omission of the intercept dummy in this specification. If we focus our attention on specifications (6) and (8), which are the dummy-adjusted equations, there is little difference in the revenue-maximizing tax rates for both specifications.

Finally, it does not appear to matter much whether the broad or narrow measure of tradable wealth is used.

Table 11 reports results for the preferred specification with the sample period spanning up to 1987. Both double-log and semi-log specifications are estimated. In addition, the sensitivity of the tax elasticity estimates to the use of the two definitions of wealth is examined.

There are several conclusions that can be drawn. First, the double-log specification provides a better fit to the data in terms of higher adjusted R-squared terms and lower Q-values. Second, both short-run and long-run tax elasticities are higher when 1987 is included in the sample. For example, in specification (1), which excludes the intercept dummy, the short-run elasticity is -1.79 and the long-run elasticity is -0.86; for specification (2), which includes the dummy variable, the short-run estimate is -1.68 and the long-run elasticity is -1.49. Third, for the semi-log specifications, the short-run and long-run revenue-maximizing tax rates are lower than they are when 1987 is omitted. Depending on whether or not a dummy variable is included, these rates range from 15.4% to 17.2% for the short-run, and from 16.9% to 30.3% for the long-run period.

Third, there is little difference between the elasticity estimates when the broad or narrow measure of tradable wealth is used. Although the results are not reported, the use of just corporate equity holdings of taxpayers resulted in similar short-run and long-run elasticities and revenue-maximizing tax rates. Finally, it is interesting to note that the moving average variable on gains is significant or close to being significant in almost all the equations.

Limitations of the Preferred Equation:

There are several weaknesses of the preferred equation specification that deserve comment. First, only ordinary least squares estimates are reported. Because of collinearity problems that resulted when instrumental-variable estimation was used for tax rates, wealth holdings, and expected tax rates and wealth holdings, the IV estimates are not reported. Specifically, problems arise in coming up with a set of instrumental variables that avoid multicollinearity problems. Additional work is being done on this currently.

Second, only perfect-foresight expectations for the marginal tax rate and the wealth measure were used. This means that the actual values for these variables were used, instead of using the one-step-ahead predicted values from an auxiliary equation. An improvement can be made by using the IV estimator suggested by Pagan (1984) to avoid the well-known problems associated with a biased variance-covariance matrix that are encountered when generated regressors are used in equations that are estimated with OLS.

Despite the weaknesses of our preferred equation, it represents an improvement over the other time-series equations. For example, the use of a broader measure of taxpayer wealth, and the use of expectations on the wealth variable produce a tax elasticity estimate that is free of the omitted variable bias that would otherwise result. In addition, the use of differenced data avoids the spurious regression phenomenon that is most likely encountered in regressions specified in terms of levels of the data. Finally, the moving average variable that models borrowing behavior has the correct sign, and is significant during periods of tax rate changes that involve announcement effects, such as occurred in 1986.

6. SUMMARY AND CONCLUSIONS

Our preferred time-series equation estimates a short-run elasticity of -1.20 and a long-run elasticity of -0.90 for the period 1948-1986. These elasticities of capital gain responsiveness to changes in tax rates show that realizations would more than double in the short-run if marginal tax rates are cut in half, and realizations would nearly double in the long-run. These estimates of the long-run elasticity are higher than most prior time-series equation estimates.

Overall, the results reported in this study show that the capital gains tax elasticity estimates produced by aggregate time-series regressions are <u>not</u> particularly robust with respect to the equation specification. Whether narrow or broad measures of taxpayer wealth are used, whether the data are differenced, the length of the sample period, and whether expectations of tax rates and other explanatory variables are used as additional regressors are specification decisions that have an impact on the estimated response of capital gains realizations to changes in the marginal tax rate.

One problem that has not been discussed is the possibility of aggregation bias. Aggregation bias results when individual relations are incorrectly aggregated into macrorelations for estimation and inference purposes. The use of aggregate time-series data to estimate tax elasticities probably suffers from such a bias, since it is unlikely that aggregation over individual taxpayers as well as aggregation over the various capital-assets that produce capital gains realizations is done correctly. In addition to the biases introduced by simultaneity between the dependent and independent variables and by omitted variables, not to mention errors-in-variables problems associated with the tax rates and wealth variables, the existence of aggregation bias also makes it a difficult undertaking to obtain an accurate tax elasticity estimate from aggregate time-series regressions.

Because of the sensitivity of the elasticity estimates to the specification of the estimating equation and the statistical uncertainty of the estimates, it would be advisable to avoid using only aggregate time-series estimates as a measure of taxpayer behavioral response to changes in capital gains taxation. A more prudent course would be to use estimates from panel or cross-section microdata in combination with estimates from time-series studies.

FOOTNOTES

[1]The argument can be made that it is inappropriate to subject the nested equations specified by Kiefer to the specification test using real data. These equations were specified and estimated by Kiefer with simulated data to make the case that lagged values of the tax rate were significant, and that their omission from the estimating equation would overstate the tax-elasticity. This is a weak argument, however, since the use of lagged tax rates in the regression specification must still receive support from actual data.

[2]Net long-term gains in excess of short-term losses represent the realizations that are actually subject to the capital gains tax. On the other hand, net short-term gains, which are included in the total capital gains measure, are taxed as ordinary income. While the decisions to realize short-term or long-term gains are related, it may be inappropriate to include both together in the dependent variable, since the relation of each to the marginal tax rate will no doubt be different.

[3]It should be noted that all three measures of the marginal tax rate sufffer from measurement problems that most likely result in errors-in-variables problems. There are measurement problems with the upper income and maximum marginal tax rates; and, in addition, Larry Ozanne has stated in correspondence with the author that unknown errors were introduced in the attempt to make the average tax rate exogenous.

[4]Under the null hypothesis, the J-statistic has an asymptotic expectation of zero, but a non-zero expectation in small samples. This means that the null hypothesis is rejected too often in small samples.

If z_0 is the test statistic under the H_0, then it can be shown that

$$E_0(z_0) = -\sigma_0^2\{\sum_{i=1}^{s}(1-\rho_i^2)+\max(k_1-k_0).0)\}$$

where ρ_i ($\rho_i^2 \leq 1$) are the s=min (k_0, k_1) canonical correlations associated with the explanatory variables in the two competing regression models, σ_0^2 is the error variance for the null model, k_1 and k_0 denote the number of explanatory variables in the alternative and null models, respectively, and E_0 is the mathematical expectation under the null hypothesis. The correlations are given by the non-zero roots of the equation:

$$|X'Z(Z'Z)^{-1}Z'X - \rho^2 X'X| = 0$$

where X and Z denote the design matrices in the null and alternative models, respectively. It is clearly the case that a poor fit to the data of the null model, a small degree of correlation among the explanatory variables in the two models, and a large discrepency between k_1 and k_0 serve to make the expectation non-zero. See Godfrey and Pesaran (1983) for further discussion.

[5]In the univariate case, the formulas used to determine optimal lag-length are given by the following:

$$FPE(n) = (T+n+1)/(T-n-1)\ SSR(n)/T$$

$$BIC(n) = SSR(n) + (nSSR(N)/T\ln T)/(T-n-1)$$

where T is the effective sample size. n is the lag-length being tested. SSR is the sum of squared residuals. and N denotes the maximum lag-legnth over which the search is carried out. Minimum FPE or BIC corresponds to the optimal lag-length.

[6] In the case where equity and tradeable wealth move in proportion. there is no bias. This is an unlikely case: and. moreover. there would be no advantage to adding the omitted variable to the design matrix. since this would result in singularity of the X'X matrix.

TABLE 1. EQUATION SPECIFICATIONS FOR CAPITAL GAINS STUDIES

DIFFERENCES

1. Cook and O'Hare, 1954-1983, JCT

RCG = B0 + B1*PRICE + B2*RGNP + B3*STOCK + B4*MTRJ
+B5*SPREAD

RCG = Change in total realized capital gains
PRICE = Change in Standard and Poor's index of stock prices
RGNP = Change in RGNP
STOCK = Change in corporate stock held by households
MTRJ = Change in maximum tax rate applied to capital gains
SPREAD = Difference between maximum rate on ordinary
and maximum tax rate applied to capital gains

2. 1985 Treasury Study, 1954-1982

RCG = B0 + B1*CRGNP + B2*CIGNP + B3*STOCK + B4*MTRT
+ B5*MTRT(-1)

RCG = Change in total realized capital gains
CRGNP = Change in RGNP
CIGNP = Change in inflationary part of GNP
STOCK = Change in corporate stock held by households
MTRT = Change in marginal tax rate on upper income returns

3. Minarik, 1954-1985

RCG = B0 + B1*CRGNP + B2*CIGNP + B3*STOCK + B4*MTRT
+B5*MTRT(-1) + B6*NYSE

RCG = Change in CBO definition of capital gains
CRGNP, CIGNP, STOCK = Same as above
MTRT = Change in CBO tax rate for top 1% of taxpayers
NYSE = Change in NYSE index

LEVELS

4. Darby et al., 1954-1985

RCG = B0 + B1*RGNP + B2*RGNP(-1) + B3*PGNP
+B4*RSTOCK + B5*MTRT

RCG = B0 + B1*RGNP +B2*RGNP(-1) + B3*PGNP
+ B4*RSTOCK + B5*ATRT

RCG = B0 + B1*RGNP + B2*RGNP(-1) + B3*PGNP
+B4*RSTOCK + B5*MTRT + B6*MTRTSQ

RCG = B0 + B1*RGNP + B2*RGNP(-1) + B3*PGNP
+ B4*RSTOCK + B5*LMTRT

RCG = Log of total realized capital gains
RGNP = Log of RGNP
PGNP = Log of GNP deflator
RSTOCK = Log of real corporate stock holdings
of households
MTRT = Marginal tax rate for high income
taxpayers
LMTRT = Log of MTRT
ATRT = Log of after-tax share, i.e.,
1-MTRT
MTRTSQ = MTRT squared

5. Kiefer, Simulation Study

RCG = B0 + B1*VALUE + B2*MTRT + B3*MTRT(-1)
+ B4*MTRT(-2) + B5*MTRT(-3) + B6*MTRT(-4)
+ B7*MTRT(-5)

RCG = Log of total realized capital gains
VALUE = Log of taxpayer's portfolio at beginning
of year
MTRT = Log of Treasury's MTR

6. Toder and Ozanne, 1954-1983, CBO

LTG = B0 + B1*PGNP + B2*RSTOCK + B3*RGNP
+ B4*MTRC

LTG = B0 + B1*PGNP + B2*RSTOCK + B3*RGNP
+ B4*dRGNP + B5*MTRC

RLTG = B0 + B1*RSTOCK + B2*RGNP + B3*MTRC

RLTG = B0 + B1*RSTOCK + B2*RGNP + B3*dRGNP
+ B4*MTRC

LTG = Log of net long-term gains in excess
of short-term losses
RLTG = Log of real LTG
MTRC = Unlogged weighted average of marginal tax
rates
dRGNP = Difference of log RGNP
RGNP, PGNP, RSTOCK = Same as above

TABLE 2.

J-STATISTICS FOR CAPITAL GAINS EQUATIONS
(LEVELS OF DATA)

Darby et al. Equations, 1954-1985		Equation #2	Equation #3	Equation #4
Equation #1 as Null Hypothesis		.13	.14	-.17
Equation #1 as Alternative Hypothesis		-.03	.66**	.48
Toder and Ozanne Equations, 1954-1985			Equation #2	
Nominal Equations	Equation #1 as Null Hypothesis		2.66	
	Equation #1 as Alternative Hypothesis		.22**	
			Equation #4	
Real Equations	Equation #3 as Null Hypothesis		2.58	
	Equation #3 as Alternative Hypothesis		1.16**	
Kiefer Equation, Simulation Study, 1954-1985			Darby et al. Eq. #4	Toder and Ozanne Eq. #2
Kiefer Equation as Null Hypothesis			For all lags rejected	For all lags rejected
Kiefer Equation as Alternative Hypothesis			For all lags not accepted	For all lags not accepted
Darby et al. and Toder and Ozanne Equations, 1954-1985				Toder and Ozanne Eq. #2
RCG as Dependent Variable	Darby Eq. #4 as Null Hypothesis			-1.54
	Darby Eq. #4 as Alternative Hypothesis			2.46
LTG as Dependent Variable	Darby Eq. #4 as Null Hypothesis			-1.75
	Darby Eq. #4 as Alternative Hypothesis			2.74

Critical values are 1.96 and 2.57 at the 5 and 1 percent levels, respectively.

**Because some of the models are so similar, collinearity proved to be a problem. In fact, in order to obtain estimates in those cases indicated, a generalized inverse matrix had to be used. Specifically, a Moore-Penrose matrix was used to obtain estimates.

TABLE 3. J-STATISTICS FOR CAPITAL GAINS EQUATIONS (FIRST-DIFFERENCES OF DATA)

Total Realized Capital Gains as Dependent Variable	Treasury Eq.	Minarik
Cook and O'Hare Equation as Null Hypothesis	5.46	3.84
Cook and O'Hare as Alternative Equation	.004	.73
Treasury Equation as Null Hypothesis	---	-.80
Treasury Equation as Alternative Hypothesis	---	3.12
Net Long Term Capital Gains as Dependent Variable	**Treasury Eq.**	**Minarik**
Cook and O'Hare as Null Hypothesis	3.40	3.89
Cook and O'Hare as Alternative Hypothesis	4.62	2.39

Critical values are 1.96 and 2.57 at the 5 and 1 percent levels, respectively.

TABLE 4. DICKEY-FULLER TESTS FOR TREND STATIONARY OR DIFFERENCE STATIONARY MODELS

Darby et al. Data	t-Statistic	Treasury Data	t-Statistic	Cook and O'Hare Data	t-Statistic
RCG	-2.38	RCG	3.00	RCG	-.40
RGNP	-1.60	RGNP	-2.93	SP	-2.45
PGNP	-1.46	PGNP	.15	RGNP	-2.71
LMTRT	-.56	MTRT	-.67	STOCK	-1.50
RSTOCK	-2.24	STOCK	-.38	MTRJ	-.14
				SPREAD	-2.30
Toder and Ozanne Data	**t-Statistic**				
LTG	-2.50				
RLTG	-1.70				
RGNP	-1.66	**Minarik Data**	**t-Statistic**		
PGNP	-2.36	NYSE	-2.05		
RSTOCK	-.55				
MTRC	-2.80				

Note: All series used are found to be DS series according to Dickey-Fuller test.

Critical value for rejecting the null hypothesis of DS model in favor of TS model at the 5 percent level is -3.60 for a sample size of 25 observations. Source is Table 8.5.2., p. 373, in Fuller, Introduction to Statistical Time Series, Wiley, 1976.

TABLE 5. AUGMENTED DICKEY-FULLER TESTS FOR STATIONARITY OF DS MODELS

Darby Data, 1954-1985

a. Levels	t-Statistic
RCG	2.57
RGNP	2.77
PGNP	1.20
MTRT	-.36
RSTOCK	.26

b. 1 Diff	t-Statistic
RCG	-.78
RGNP	-.69
PGNP	-.30
MTRT	-1.96
RSTOCK	-1.25

c. 2 Diff	t-Statistic
RCG	-4.44
RGNP	-3.44
PGNP	-2.00
MTRT	-1.83
RSTOCK	-2.78

Treasury Data, 1954-1985

a. Levels	t-Statistic
RCG	1.77
RGNP	3.35
PGNP	1.06
MTRT	2.83
STOCK	-.49

b. 1 Diff	t-Statistic
RCG	1.80
RGNP	-.32
PGNP	.21
MTRT	.56
STOCK	-1.92

c. 2 Diff	t-Statistic
RCG	-2.12
RGNP	-3.41
PGNP	-2.07
MTRT	-2.26
STOCK	-2.20

Toder and Ozanne Data, 1954-1983

a. Levels	t-Statistic
LTG	2.47
PGNP	1.20
RGNP	2.71
RSTOCK	.29
MTRC	-.43
RLTG	1.65

b. 1 Diff	t-Statistic
LTG	-.76
PGNP	-.29
RGNP	-.71
RSTOCK	-1.20
MTRC	-1.96
RLTG	-1.59

c. 2 Diff	t-Statistic
LTG	-4.29
PGNP	-1.99
RGNP	-3.44
RSTOCK	-2.78
MTRC	-3.05
RLTG	-4.27

Cook and O'Hare Data, 1954-1985

a. Levels	t-Statistic
RCG	1.90
SP	1.18
RGNP	2.23
STOCK	1.01
MTRJ	.05
SPREAD	-2.17

b. 1 Dif	t-Statistic
RCG	-.49
SP	1.16
RGNP	-.56
STOCK	-.08
MTRJ	-1.32
SPREAD	-1.69

c. 2 Diff	t-Statistic
RCG	-3.06
SP	-1.97
RGNP	-3.24
STOCK	-2.20
MTRJ	-3.01
SPREAD	-4.00

Minarik Data, 1954-1985

a. Levels	t-Statistic
NYSE	1.11

b. 1 Diff	t-Statistic
NYSE	.40

c. 2 Diff	t-Statistic
NYSE	-1.95

Critical values are -3.17 and -2.84 at the 5 and 10 percent levels, respectively. Because it was already established in Table 4 that all series have a unit root, this test establishes the degree of differencing necessary to achieve stationarity of the data.

TABLE 6. BIC AND FPE LAG LENGTHS FOR DARBY EQUATION #4

BIC Criterion	Lags	FPE Criterion	Lags
RCG	1	RCG	3
RGNP	0	RGNP	0
PGNP	1	PGNP	2
MTRT	0	MTRT	0
RSTOCK	2	RSTOCK	2

BIC Criterion	FPE Criterion
Coefficient on MTRT = -.83 t-value = -3.17	Coefficient on MTRT = -.61 t-value = -2.22
Adj. R-Squared = .98	Adj. R-Squared = .98
Standard Error of Estimate = .09	Standard Error of Estimate = .09
Box-Llung Q = 13.55 Marginal significance = .55	Box-Llung Q = 15.57 Marginal significance = .34

Note: The BIC criterion due to Schwarz (1978) is given by the expression BIC(k) = ln(SSR/T) + klnT/T where k is lag length, SSR is the sum of squared residuals, and T is the effective sample size. The alternative FPE criterion due to Akaike (1970) is given by FPE(k) = (T+k+1)/(T-k-1) x SSR/T, where the notation is the same as above.

Table 7

Specification Searching Results
1948–1986
(First-Differences of Logs)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample Period	1954–1985	1954–1985	1954–1986	1954–1986	1948–1985	1948–1985	1948–1986	1948–1986
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Constant	-10.81	-1.95	-5.50	3.25	1.19	4.13	5.03	7.78
	(-1.40)	(-.31)	(-.52)	(.37	(.16)	(.70)	(.56)	(1.05)
RGNP	4.89	3.28	4.66	2.98	3.10	1.81	2.93	1.40
	(5.01	(3.91)	(3.48)	(2.48)	(3.58)	(2.56)	(2.78)	(1.73)
RGNP (-1)	-1.25	-2.06	-1.30	-2.13	-1.62	-1.81	-1.68	-1.86
	(-1.38)	(-2.68)	(-1.04)	(-1.93)	(-1.97)	(-2.66)	(-1.68)	(-2.14)
PGNP	1.68	.28	1.07	-.33	.47	-.34	.06	-.75
	(1.67)	(.35)	(.78)					
Equity	.73	—	.76	—	.71	—	.73	—
	(5.47)		(4.17)		(5.03)		(4.26)	
Tradeable Wealth	—	2.35	—	2.51	—	2.50	—	2.59
		(6.79)		(5.07)		(6.97)		(5.66)
MTR	-.84	-1.07	-.84	-1.08	-.80	-.97	-.79	-.97
	(-2.63)	(-3.90)	(-1.91)	(-2.74)	(-2.19)	(-3.22)	(-1.78)	(-2.51)
Adj. R-Sq.	.651	.731	.488	.571	.566	.695	.467	.584
D-W Statistic	2.33	1.85	1.65	1.16	2.52	2.33	1.94	1.60
Box-Ljung Q Statistic	10.54(.78)	11.52(.71)	7.04(95)	5.99(.97)	12.52(.81)	10.10(.92)	16.65(.58)	12.38(.82)
Deg. of Freedom	24	24	25	25	30	30	31	31

Table 8
Final Equation
Specification Searching Results
1948–1986
(First-Differences of Logs)

Specification Sample Period Estimation Method	(1) 1954–1985 OLS	(2) 1954–1985 OLS	(3) 1954–1986 OLS	(4) 1954–1986 OLS	(5) 1948–1985 OLS	(6) 1948–1985 OLS	(7) 1948–1986 OLS	(8) 1948–1986 OLS
Constant	-4.83	-.83	-9.71	-5.48	-.62	4.00	-5.34	-.71
	(-.51)	(-.11)	(-.86)	(-.69)	(-.07)	(.60)	(-.54)	(-.09)
RGNP	4.22	3.27	5.03	3.81	3.56	2.86	4.12	2.86
	(3.64)	(3.62)	(3.68)	(3.85)	(3.74)	(3.24)	(3.59)	(3.30)
RGNP(-1)	-.79	-1.76	-1.53	-2.32	-.29	-1.00	-.63	-1.28
	(-.73)	(-1.95)	(-1.20)	(-2.32)	(-.37)	(-1.50)	(-.66)	(-1.68)
PGNP	1.31	.46	1.70	.81	.96	.05	1.41	.44
	(1.10)	(.53)	(1.19)	(.84)	(.92)	(.06)	(1.11)	(.50)
Equity	.65	—	.70	—	.71	—	.77	—
	(4.42)		(3.92)		(5.34)		(4.75)	
Tradeable Wealth	—	2.33	—	2.62	—	2.40	—	2.70
		(6.16)		(6.43)		(6.70)		(6.85)
Moving Average	-.33	-.05	.12	.28	-.50	-.32	-.15	-.03
on Gains	(-.99)	(-.19)	(.35)	(1.02)	(-1.88)	(-1.36)	(-.50)	(-.12)
MTR	-1.01	-1.15	-1.00	-1.13	-1.01	-1.17	-.99	-1.14
	(-2.88)	(-4.23)	(-2.36)	(-3.69)	(-3.06)	(-4.29)	(-2.46)	(-3.66)
MTR(+1)	.02	.41	.80	.95	-.08	.28	.73	.89
	(.07)	(1.41)	(2.63)	(4.20)	(-.26)	(.99)	(2.55)	(3.94)
Equity(+1)	-.13	—	-.17	—	-.14	—	-.16	—
	(-.91)		(-.94)		(-1.13)		(-1.06)	
Tradeable Wealth(+1)	—	-.62	—	-.61	—	-.67	—	-.68
		(-1.67)		(-1.45)		(-2.11)		(-1.86)
Adj. R-Sq.	.613	.740	.566	.747	.667	.750	.599	.734
Box-Ljung Q Statistic	16.10(.30)	10.36(.73)	10.74(.70)	6.87(.93)	19.70(.18)	12.86(.61)	16.81(.33)	8.77(.88)
Deg. of Freedom	19	19	20	20	25	25	26	26

Critical t-values for a two-sided hypothesis test are as follows: 1.729 and 2.093 at the 10 and 5 percent levels, respectively, for equations with 19 degrees of freedom, 1.725 and 2.086 for equations with 20 degrees of freedom, 1.708 and 2.060 for equations with 25 degrees of freedom, and 1.706 and 2.056 for equations with 26 degrees of freedom.

Table 9
Final Equation with Intercept Dummy Variable for 1986
Specification Searching Results
1948-1986
(First Differences of Logs)

Specification Sample Period Estimation Method	(3) 1954-1986 OLS	(4) 1954-1986 OLS	(7) 1948-1986 OLS	(8) 1948-1986 OLS
Constant	-4.83	-.83	-.62	4.00
	(-.51)	(-.11)	(-.07)	(.60)
RGNP	4.22	3.27	3.56	2.48
	(3.64)	(3.62)	(3.74)	(3.24)
RGNP(-1)	-.79	-1.76	-.29	-1.00
	(-.73)	(-1.96)	(-.37)	(-1.50)
PGNP	1.31	.46	.96	.05
	(1.10)	(.53)	(.92)	(.06)
Equity	.65	---	.71	---
	(4.42)		(5.34)	
Tradeable Wealth	---	2.33	---	2.40
		(6.16)		(6.70)
Moving Average	-.33	-.05	-.50	-.32
on Gains	(-.99)	(-.19)	(-1.88)	(-1.36)
MTR	-1.01	-1.15	-1.01	-1.17
	(-2.88)	(-4.23)	(-3.06)	(-4.29)
MTR(+1)	.02	.41	-.08	.28
	(.07)	(1.41)	(-.26)	(.99)
Equity(+1)	-.13	---	-.14	---
	(-.91)		(-1.17)	
Tradeable Wealth(+1)	---	-.62	---	-.67
		(-1.67)		(-2.11)
Dummy	56.17	37.81	59.82	43.69
	(3.20)	(2.52)	(3.71)	(3.03)
Adj. R-Sq.	.703	.801	.731	.798
Box-Ljung Q Statistic	16.41(.28)	10.55(.72)	20.06(.16)	13.09(.59)
Degree of Freedom	19	19	25	25

Table 10
Specification Searching Results
(Net Long Term Gains And Treasury's Upper Income Marginal Tax Rate)
1948-1986
(First - Differences)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]	(8)[a]
Sample Period	1948-1986	1948-1986	1948-1986	1948-1986	1948-1986	1948-1986	1948-1986	1948-1986
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Functional Form	Double-Log	Double-Log	Semi-Log	Semi-Log	Semi-Log	Semi-Log	Semi-Log	Semi-Log
Constant	2.00	6.00	3.12	7.62	1.74	6.59	.21	6.10
	(.21)	(.63)	(.30)	(.76)	(.15)	(.63)	(.02)	(.78)
RGNP	2.66	2.35	2.52	2.19	3.15	2.72	3.19	2.66
	(2.41)	(2.21)	(2.23)	(2.03)	(2.57)	(2.34)	(3.02)	(2.98)
RGNP(-1)	-.38	-.29	-.38	-.33	-.08	-.04	-1.00	-.82
	(-.40)	(-.32)	(-.39)	(-.36)	(-.08)	(-.05)	(-1.08)	(-1.07)
PGNP	-.10	-.55	-.19	-.64	.54	-.44	.64	.14
	(-.09)	(-.48)	(-.15)	(-.55)	(.04)	(-.35)	(.56)	(.15)
Broad Trade. Wealth	2.49	2.28	2.46	2.21	---	---	---	---
	(5.10)	(4.76)	(4.86)	(4.49)				
Narrow Trade. Wealth	---	---	---	---	1.54	1.39	1.69	1.46
					(4.17)	(3.95)	(5.19)	(5.24)
Moving Average on Gains	-.08	-.25	-.08	-.27	-.07	-.28	-.06	-.41
	(-.31)	(-.91)	(-.31)	(-.97)	(-.25)	(-.95)	(-.22)	(-1.57)
MTR	-1.19	-1.20	-.040	-.041	-.037	-.039	-.035	-.038
	(-3.03)	(-3.16)	(-2.74)	(-2.97)	(-2.34)	(-2.59)	(-2.53)	(-3.27)
MTR(+1)	.75	.24	.027	.007	.023	.002	.029	.002
	(2.58)	(.61)	(2.35)	(.54)	(1.91)	(.16)	(2.76)	(.21)
Broad T.W.(+1)	-.86	-.78	-.84	-.77	---	---	---	---
	(-1.88)	(-1.77)	(-1.77)	(-1.77)				
Narrow T.W.(+1)	---	---	---	---	-.57	-.51	-.45	-.45
					(-1.63)	(-1.57)	(-1.50)	(-1.62)
Intercept Dummy	---	35.54	---	37.44	---	42.00	---	53.64
		(1.82)		(2.01)		(2.19)		(3.54)
Adj. R-Sq.	.504	.618	.560	.606	.509	.572	.622	.738
D.W.	1.86	1.79	1.81	1.76	1.92	1.84	2.04	2.16
Deg. of Freedom	26	25	26	25	26	25	26	25
S.R. Elasticity	-1.19	-1.20	---	---	---	---	---	---
L.R. Elasticity	-.44	-.96	---	---	---	---	---	---
S.R. Rev. Max. Rate	---	---	25.0%	24.4%	27.0%	25.6%	28.5%	26.3%
L.R. Rev. Max. Rate	---	---	76.9%	27.0%	71.4%	27.0%	**	27.8%

[a] Dep. Var. is total realized gains.
** The coefficient sum resulted in a nonsensical L.R. tax rate

Table 11
Specification Searching Results
(Total Realized Gains And Treasury's Upper Income Marginal Tax Rate)
1948-1987
(First - Differences)

Specification Estimation Method Functional Form	(1) OLS Double-Log	(2) OLS Double-Log	(3) OLS Double-Log	(4) OLS Double-Log	(5) OLS Semi-Log	(6) OLS Semi-Log	(7) OLS Semi-Log	(8) OLS Semi-Log
Constant	2.67 (.32)	7.57 (1.02)	1.47 (.16)	6.42 (.82)	5.46 (.57)	11.05 (1.38)	4.33 (.43)	9.64 (1.16)
RGNP	2.97 (3.00)	2.50 (2.91)	3.60 (3.27)	3.02 (3.21)	2.72 (2.49)	2.21 (2.41)	3.32 (2.81)	2.71 (2.76)
RGNP(-1)	-1.01 (-1.16)	-.78 (-1.05)	-.69 (-.72)	-.47 (-.59)	-.98 (-1.02)	-.79 (-.99)	-.68 (-.66)	-.51 (-.62)
PGNP	.26 (.25)	-.17 (-.20)	.54 (.47)	.07 (.07)	.07 (.06)	-.35 (-.37)	.32 (.25)	-.11 (-.11)
Broad Trade. Wealth	2.52 (5.62)	2.20 (5.56)	---	---	2.43 (4.89)	2.04 (4.78)	---	---
Narrow Trade. Wealth	---	---	1.57 (4.73)	1.39 (4.87)	---	---	1.52 (4.22)	1.30 (4.33)
Moving Average on Gains	-.39 (-1.61)	-.66 (-2.92)	-.41 (-1.56)	-.69 (-2.91)	-.49 (-1.85)	-.78 (-7.33)	-.50 (-1.78)	-.80 (-3.28)
MTR	-1.79 (-6.65)	-1.68 (-7.22)	-1.68 (-5.62)	-1.57 (-6.18)	-.065 (-5.73)	-.062 (-6.50)	-.062 (-5.00)	-.058 (-5.75)
MTR(+1)	.93 (3.57)	.19 (.60)	.85 (2.97)	.04 (.13)	.032 (2.92)	.003 (.26)	.029 (2.43)	-.001 (-.12)
Broad T.W.(+1)	-.83 (-2.00)	-.76 (-2.15)	---	---	-.82 (-1.79)	-.77 (-2.04)	---	---
Narrow T.W.(+1)	---	---	-.52 (-1.68)	-.46 (-1.76)	---	---	-.55 (-1.62)	-.49 (-1.76)
Intercept Dummy	---	52.08 (3.29)	---	57.80 (3.46)	---	57.27 (3.62)	---	61.47 (3.78)
Adj. R-Sq.	.781	.840	.743	.817	.734	.817	.704	.801
Box-Ljung Q-Stat.	18.33(.43)	23.04(.18)	25.15(.12)	24.13(.15)	14.95(.66)	20.68(.29)	20.02(.33)	21.81(.24)
Deg. of Freedom	27	26	27	26	27	26	27	26
S.R. Elasticity	-1.79	-1.68	-1.68	-1.57	---	---	---	---
L.R. Elasticity	-.86	-1.49	-.83	-1.53	---	---	---	---
S.R. Rev. Max. Rate	---	---	---	---	15.4%	16.1%	16.1%	17.2%
L.R. Rev. Max. Rate	---	---	---	---	30.3%	16.9%	30.3%	16.9%

Appendix A
Results for Alternative Specifications Using Additional Variables (Differenced Data)

Specification:	(1)	(2)	(3)	(4)
Sample Period:	1956-1985	1956-1985	1956-1985	1956-1985
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.10 (-1.40)	.02 (.32)	-.06 (-1.16)	-.06 (-1.13)
RGNP	4.89 (5.01)	5.15 (4.18)	3.32 (4.22)	3.32 (3.61)
RGNP(-1)	-1.25 (-1.38)	-2.79 (-2.62)	-2.09 (-2.91)	-2.09 (-2.81)
Price Deflator	1.68 (1.67)	-.23 (-.21)	.52 (.69)	.52 (.67)
Equity	.73 (5.47)	---	---	---
MTR (Upper Income)	-.84 (-2.63)	-1.36 (-3.50)	-1.08 (-7.48)	-1.08 (-3.95)
Accrued Gains	---	.07 (3.47)	---	.0001 (.008)
Net Worth	---	---	3.43 (7.43)	3.43 (5.28)
Stock Repurchases	---	---	---	---
Total Non-Fin. Assets	---	---	---	---
Total Financial Assets	---	---	---	---
Adj. R-Squared	.651	.479	.764	.754
D-W Statistic	2.33	2.28	2.21	2.21
Log-Likelihood	27.04	21.00	32.94	32.94
D.F.	24	24	24	23

Notes: t-statistics are in parentheses.
The equity, accrued gains, net worth, stock repurchases, total non-financial and total financial asset variables are expressed in real terms.

Appendix A
Results for Alternative Specifications Using Additional Variables (Differenced Data)

Specification:	(5)	(6)	(7)	(8)
Sample Period:	1972-1985	1972-1985	1972-1985	1956-1985
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	.20	.17	.13	-.11
	(1.70)	(1.68)	(2.34)	(-1.72)
RGNP	2.62	3.57	2.21	3.72
	(2.31)	(3.01)	(3.06)	(3.44)
RGNP(-1)	-1.74	-1.98	-1.49	-1.60
	(-1.79)	(-2.26)	(-2.14)	(-1.85)
Price Deflator	-2.08	-1.92	-1.66	1.28
	(-1.43)	(-1.51)	(-2.39)	(1.45)
Equity	---	---	---	---
MTR (Upper Income)	-1.02	-1.18	-1.01	-.86
	(-3.41)	(-4.31)	(-6.52)	(-2.78)
Accrued Gains	---	.07	.01	.004
		(1.88)	(.75)	(.21)
Net Worth	---	---	1.88	---
			(4.20)	
Stock Repurchases	.03	-.009	.001	---
	(.50)	(-.14)	(.05)	
Total Non-Fin. Assets	---	---	---	.12
				(.14)
Total Financial Assets	---	---	---	2.61
				(5.37)
Adj. R-Squared	.543	.654	.897	.754
D-W Statistic	1.73	1.89	2.52	2.18
Log-Likelihood	17.37	20.20	17.29	13.71
D.F.	8	7	6	22

Appendix A
Results for Alternative Specifications Using Additional Variables (Differenced Data)

Specification:	(9)	(10)	(11)	
Sample Period:	1955-1985	1955-1985	1955-1985	
Estimation Method:	OLS	OLS	OLS	
Differenced:	YES	YES	YES	
Logged:	YES	YES	YES	
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	
Constant	-.11	.02	-.11	
	(-1.84)	(.28)	(-1.78)	
RGNP	3.81	5.23	3.62	
	(4.41)	(3.36)	(3.81)	
RGNP(-1)	-1.54	-2.74	-1.58	
	(-2.05)	(-2.19)	(-1.87)	
Price Deflator	1.33	-1.93	1.29	
	(1.66)	(-.15)	(1.49)	
Equity	---	---	---	---
MTR (Upper Income)	-.84	-1.35	-.84	
	(-3.02)	(-3.07)	(-2.98)	
Accrued Gains	.005	.07	---	
	(.24)	(3.35)		
Net Worth	---	---	---	
Stock Repurchases	---	---	---	
Total Non-Fin. Assets	---	-.11	.16	
		(-.08)	(.19)	
Total Financial Assets	2.61	---	2.68	
	(5.49)		(7.48)	
Adj. R-Squared	.764	.456	.764	
D-W Statistic	2.17	2.28	2.19	
Log-Likelihood	33.56	21.01	33.55	
D.F.	23	23	23	

Appendix B
Alternative Specification Results for Variables from Individual, NonFarm, and Farm Balance Sheets (Differences Logged Data)

Specification:	(1)	(2)	(3)	(4)
Sample Period:	1955-1985	1955-1985	1955-1985	1955-1985
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.10 (-1.42)	-.25 (-2.39)	.06 (.67)	-.21 (-1.60)
RGNP	4.84 (4.68)	5.11 (5.33)	4.37 (2.87)	4.46 (3.01)
RGNP(-1)	-1.22 (-1.34)	-.91 (-1.04)	-2.86 (-2.20)	-1.17 (-1.17)
PGNP	1.68 (1.68)	3.30 (2.56)	-.44 (-.32)	2.50 (1.31)
Corp. Equity	.74 (5.49)	---	---	---
MTR	-.83 (-2.62)	-.65 (-2.02)	-1.15 (-2.49)	-.70 (-2.70)
Investment Co.	---	.75 (2.01)	---	.70 (1.82)
Other Equity	---	.10 (.30)	---	.11 (.33)
Non-Residential Land	---	.66 (1.60)	---	.33 (.46)
Net Purchases	---	---	.04 (1.02)	---
Non-Corp. Assets	---	---	---	.91 (.57)
Adj. R-Squared	.652	.674	.249	.664
D-W Statistics	2.34	2.38	2.48	2.36
Log-Likelihood	11.90	9.58	15.52	29.60
D.F.	24	22	24	21

Appendix C
Results for One-Period-Ahead Expectations and Moving-Average on Lagged Gains (Differenced Logged Data)

Specification:	(1)	(2)	(3)	(4)
Sample Period:	1956-1984	1956-1984	1956-1984	1956-1984
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.12	-.07	-.11	-.04
	(-1.50)	(-.91)	(-1.18)	(-.54)
RGNP	5.03	4.48	4.82	4.24
	(4.88)	(4.52)	(4.69)	(4.34)
RGNP (-1)	-1.29	-1.31	-1.24	-2.54
	(-1.29)	(-1.36)	(-1.21)	(-2.27)
PGNP	1.95	1.25	1.71	-2.56
	(1.78)	(1.21)	(1.56)	(1.12)
MTR	-.85	-1.00	-.85	-1.09
	(-2.57)	(-2.99)	(-2.47)	(-3.31)
MTR(+1)	.25	---	---	---
	(.77)			
Corp. Equity	.73	.68	.72	.64
	(5.02)	(4.73)	(3.90)	(4.54)
RGNP(+1)	---	---	.17	---
			(.12)	
PGNP(+1)	---	---	---	4.03
				(2.05)
Corp. Equity (+1)	---	-.19	---	---
		(-1.53)		
AVEG 2	---	---	---	---
AVEG 3	---	---	---	---
AVEG 4	---	---	---	---
AVEG 5	---	---	---	---
Adj. R-Squared	.640	.666	.630	.689
D-W Statistic	2.37	2.42	2.33	2.42
Log-Likelihood	26.29	27.17	25.71	28.24
D.F.	22	22	22	22

Appendix C
Results for One-Period-Ahead Expectations and Moving-Average on Lagged Gains (Differenced Logged Data)

Specification:	(5)	(6)	(7)	(8)
Sample Period:	1957-1985	1958-1985	1959-1985	1960-1985
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.11 (-1.46)	-.05 (-.67)	-.03 (-.85)	-.04 (-.41)
RGNP	4.93 (4.99)	4.31 (4.13)	4.48 (4.14)	4.73 (4.31)
RGNP(-1)	-.46 (-.43)	-.72 (-.70)	-1.08 (-1.17)	-.97 (-.95)
PGNP	1.84 (1.81)	1.54 (1.46)	1.70 (1.59)	1.62 (1.46)
MTR	-.85 (-2.65)	-.91 (-2.80)	-.93 (-2.96)	-.89 (-2.75)
MTR(+1)	---	---	---	---
Corp. Equity	.69 (4.93)	.67 (4.64)	.75 (5.23)	.70 (4.92)
RGNP(+1)	---	---	---	---
PGNP(+1)	---	---	---	---
Corp. Equity(+1)	---	---	---	---
AVEG 2	-.28 (-1.37)	---	---	---
AVEG 3	---	-.43 (-1.43)	---	---
AVEG 4	---	---	-.75 (-2.08)	---
AVEG 5	---	---	---	-.76 (-2.00)
Adj. R-Sqared	.659	.636	.670	
D-W Statistic	2.25	2.37	2.35	
Log-Likelihood	26.88	25.99	26.08	
D.F.	22	21	20	

Appendix C
Results for One-Period-Ahead Expectations and Moving-Average on Lagged Gains (Differenced Logged Data)

Specification:	(9)	(10)	(11)	(12)
Sample Period:	1957-1984	1958-1984	1959-1984	1960-1984
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.06	-.03	-.01	-.009
	(-.84)	(-.42)	(-.11)	(-.09)
RGNP	4.47	4.11	4.27	4.45
	(4.46)	(2.81)	(3.82)	(3.95)
RGNP(-1)	-.45	-.89	-1.21	-1.08
	(-.41)	(-.80)	(-1.21)	(-.99)
PGNP	1.31	1.23	1.40	1.25
	(1.27)	(1.11)	(1.26)	(1.09)
MTR	-1.05	-1.03	-1.07	-1.05
	(-3.15)	(-2.95)	(-3.16)	(-3.08)
MTR(+1)	---	---	---	---
Corp. Equity	.61	.67	.70	.65
	(4.09)	(4.03)	(4.52)	(4.23)
RGNP(+1)	---	---	---	---
PGNP(+1)	---	---	---	---
Corp. Equity(+1)	-.23	-.15	-.15	-.18
	(-1.74)	(-1.02)	(-1.09)	(-1.34)
AVEG 2	-.32	---	---	---
	(-1.57)			
AVEG 3	---	-.36	---	---
		(-1.12)		
AVEG 4	---	---	-.71	---
			(-1.91)	
AVEG 5	---	---	---	-.77
				(-2.01)
Adj. R-Squared	.684	.633	.672	.664
D-W Statistic	2.28	2.43	2.38	2.34
Log-Likelihood	27.50	25.41	25.69	24.01
D.F.	20	19	18	17

Appendix C
Results for One-Period-Ahead Expectations and Moving-Average on Lagged Gains (Differenced Logged Data)

Specification:	(13)	(14)	(15)	(16)
Sample Period:	1957-1984	1958-1984	1959-1984	1960-1984
Estimation Method:	OLS	OLS	OLS	OLS
Differenced:	YES	YES	YES	YES
Logged:	YES	YES	YES	YES
Dep. Var.	Nom. Gains	Nom. Gains	Nom. Gains	Nom. Gains
Constant	-.05	-.007	-.006	-.0009
	(-.62)	(-.08)	(-.07)	(-.009)
RGNP	4.38	3.89	4.12	4.30
	(4.41)	(3.73)	(3.70)	(3.75)
RGNP(-1)	-1.88	-2.06	-2.21	-2.09
	(-1.48)	(-1.63)	(-1.85)	(-1.64)
PGNP	-2.24	-2.15	-1.35	-1.49
	(-.96)	(-.90)	(-.54)	(-.60)
MTR	-1.10	-1.14	-1.12	-1.08
	(-3.31)	(-3.33)	(-3.31)	(-3.12)
MTR(+1)	---	---	---	---
Corp. Equity	.59	.59	.66	.62
	(4.00)	(3.82)	(4.27)	(4.03)
RGNP(+1)	---	---	---	---
PGNP(+1_	3.86	3.54	2.87	2.97
	(1.94)	(3.82)	(1.36)	(1.39)
Corp. Equity(+1)	---	---	---	---
AVEG 2	-.26	---	---	---
	(-1.31)			
AVEG 3	---	-.38	---	---
		(-1.27)		
AVEG 4	---	---	-.65	---
			(-1.72)	
AVEG 5	---	---	---	-.66
				(-1.66)
Adj. R-Squared	.694	.665	.683	.666
D-W Statistic	2.29	2.40	2.34	2.33
Log-Likelihood	27.94	26.64	26.13	24.96
D.F.	20	19	18	17

APPENDIX D

DATA

Year	Real-izations	Marginal Tax Rate	Real GNP	GNP Deflator	Corporate Equity	Tradeable Wealth
1948	3.66	25.00	1108.7	23.6	100.1	500.7
1949	2.87	25.00	1109.0	23.5	109.4	518.2
1950	4.76	25.00	1203.7	23.9	133.6	600.7
1951	4.79	25.00	1328.2	25.1	156.2	663.4
1952	5.50	25.00	1380.0	25.5	170.3	696.9
1953	4.94	25.00	1435.3	25.9	162.3	705.7
1954	7.16	25.00	1416.2	26.3	235.0	802.7
1955	9.88	25.00	1494.9	27.2	286.2	891.2
1956	9.86	25.00	1525.6	28.1	305.0	954.4
1957	8.11	25.00	1551.1	29.1	267.2	946.0
1958	9.44	25.00	1539.2	29.7	373.2	1085.3
1959	13.14	25.00	1629.1	30.4	401.8	1142.5
1960	11.75	25.00	1665.3	30.9	395.3	1171.4
1961	16.00	25.00	1708.7	31.2	500.7	1298.2
1962	13.45	25.00	1799.4	31.9	437.0	1262.7
1963	14.58	25.00	1873.3	32.4	513.5	1362.4
1964	17.43	25.00	1973.3	32.9	564.0	1456.8
1965	21.48	25.00	2087.6	33.8	634.9	1571.8
1966	21.35	25.00	2208.3	35.0	574.7	1589.6
1967	27.54	25.00	2271.4	35.9	719.2	1778.2
1968	35.61	26.87	2365.6	37.7	856.4	2010.5
1969	31.44	27.50	2423.3	39.8	744.5	1980.5
1970	20.85	28.91	2416.2	42.0	727.0	2016.7
1971	28.34	29.82	2484.8	44.4	830.9	2244.0
1972	35.87	30.50	2608.5	46.5	918.5	2490.8
1973	35.76	30.91	2744.1	49.5	707.2	2556.6
1974	30.22	31.55	2729.3	54.0	491.6	2577.8
1975	30.90	31.81	2695.0	59.3	637.2	2903.8
1976	39.49	33.49	2826.7	63.1	754.2	3338.6
1977	45.34	33.77	2958.6	67.3	708.7	3725.9
1978	50.53	34.13	3115.2	72.2	704.9	4310.5
1979	73.44	25.97	3192.4	78.6	856.9	5041.2
1980	74.58	26.67	3187.1	85.7	1163.3	5857.8
1981	80.94	24.81	3248.8	94.0	1104.0	6310.1
1982	90.15	20.00	3166.0	100.0	1240.0	6378.6
1983	119.12	20.00	3279.1	103.9	1421.4	6875.4
1984	138.66	20.00	3501.4	107.7	1440.8	7039.8
1985	168.57	20.00	3618.6	110.9	1888.3	7623.3
1986	333.35	20.00	3721.6	113.9	2207.3	8267.4
1987	140.0	28.00	3847.0	117.7	2106.8	8594.9
1988	---	28.00	---	120.9	2229.6	9041.7

Realizations: Net long-term captial gains in excess of net short-term capital losses plus net short-term gains for taxpayers with gains. Computed from <u>Statistics of Income</u>. (Reported in billions of current dollars).

Marginal Tax Rate: Treasury's measure for upper income taxpayers.

Real GNP and GNP Deflator: NIPA, GNP is in billions of 1982 dollars.

Corporate Equity: Total holdings of housholds, personal trusts, and non-profit organizations taken from Flow of Farms, Balance Sheets for the U.S. Economy. (Reported in billions of current dollars). Funds

Tradeable Wealth: Sum of values of land, residential structures, corporate equity, and equity in non-corporate businesses held by households. Taken from Flow of Funds, Balance Sheets for the U.S. Economy. (Reported in billions of current dollars).

APPENDIX E

This short appendix examines the correlation among various time-series variables used in the aggregate capital gains study. The particular issue that is addressed is whether the non-tax variables that are used as regressors provide information that is sufficiently uncorrelated with that provided by the marginal tax rate on capital gains realizations. If the correlation is high, then there are problems with multicollinearity which would have an impact on hypothesis testing. The non-tax variables measure economic activity and taxpayer wealth, and include, e.g., such variables as real GNP and equity holdings. Besides the non-tax explanatory variables, correlation coefficients are calculated for each of the marginal tax rates and total as well as net long term capital gains realizations.

Table 1 provides simple Pearson correlation coefficients computed for a selected set of variables that proxy economic activity and taxpayer wealth. Marginal significance levels are in parentheses. In addition, Table 2 provides correlation coefficients computed for the four alternative marginal tax rates that were used in the regressions that were estimated. These include: Treasury's upper income tax rate (MTR), CBO's weighted average tax rate (CMTR), the JCT's maximum tax rate on capital gains (MTRJ), and the twice median income marginal tax rate (MTRM). The twice median income tax rate is the marginal tax rate adjusted for the appropriate exclusion rate applicable to a 4 person family with taxable income of twice the national median income.

Table A1. Non-Tax Variables and Marginal Tax Rates

	MTR	CMTR	MTRJ	MTRM
Total realized gains	-0.406 (.0102)	-0.392 (.0262)	-0.134 (.4797)	0.616 (.0003)
Net long term gains	-0.141 (.4552)	-0.392 (.0264)	-0.128 (.4991)	0.614 (.0003)
Real GNP	0.035 (.8321)	0.042 (.8176)	0.303 (.1036)	0.840 (.0001)
Nominal GNP	0.030 (.8749)	-0.213 (.2409)	0.017 (.9279)	0.764 (.0001)
Equity holdings	-0.307 (.0571)	-0.327 (.0673)	-0.056 (.7665)	0.568 (.0010)
Tradeable wealth	-0.274 (.0912)	-0.043 (.1784)	-0.054 (.7737)	0.723 (.0001)
NYSE	0.034 (.8561)	0.033 (.8599)	0.048 (.8005)	0.616 (.0003)

Table A2. Correlation Among the Marginal Tax Rates

	MTR	CMTR	MTRJ
CMTR	0.963 (.0001)		
MTRJ	0.957 (.0001)	0.910 (.0001)	
MTRM	0.594 (.0005)	0.628 (.0002)	0.521 (.0031)

Several interesting conclusions can be drawn from examination of the correlation coefficients. First, in general, it appears that the non-tax variables provide information that is different from that provided by the marginal tax rates that are considered. The salient exception to this is the median marginal rate which is extremely highly correlated with all the non-tax variables. In addition, the simple correlation between the median rate and both measures of realizations has the wrong behavioral algebraic sign. These correlation results explain why the regression results using the median tax rate were so poor. Because of the manner in which the median rate was constructed, it is inappropriate to use this rate to assess the impact of tax rate changes on capital gains realizations.

It should also be noted that the correlation between equity holdings and both the Treasury and CBO rates is significant at almost the 5 percent level. Also, the Treasury rate is highly correlated with tradeable wealth.

Second, the correlations among the four tax rates show that the Treasury, CBO, and maximum tax rates are very close to being perfectly collinear, while the median marginal rate is not.

Finally, the significance and size of the correlation of the Treasury, CBO, and maximum tax rates with realizations varies considerably. For example, both the Treasury and CBO rates are highly correlated to about the same degree with total realizations, while the correlation between the maximum rate and total realizations is very different. For net long term realizations, the CBO tax rate remains highly correlated, but both the Treasury and maximum tax rates are not.

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